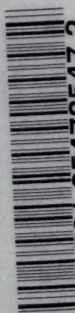
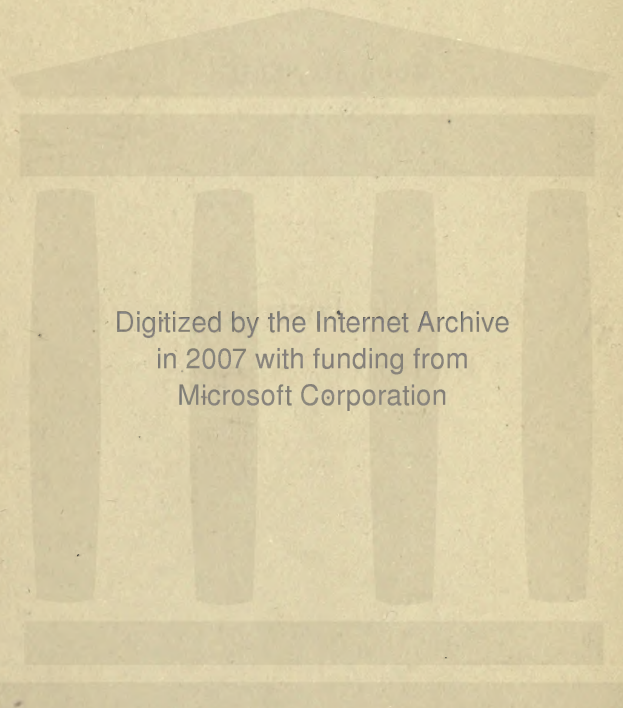


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MEDICAL SERIES

No. IV.

Course of Instruction in
Operative Surgery

SHERRATT & HUGHES
Publishers to the Victoria University of Manchester
Manchester : 27 St. Ann Street
London : 60 Chandos Street, W.C.

MS.
X.

COURSE OF INSTRUCTION

IN

OPERATIVE SURGERY

IN THE

University of Manchester

BY

WM. THORBURN, B.S. (Lond), F.R.C.S.

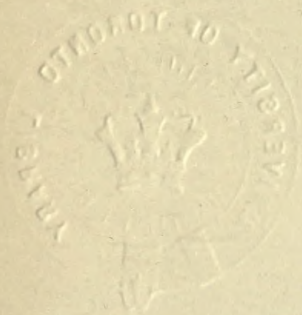
Lecturer in Operative Surgery.

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No. XI.

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Operative Surgery.

INTRODUCTION.

THE organisation of a course of instruction in operative surgery on the dead body has been found to present considerable difficulties, of which the most important are the impossibility of accurately reproducing the conditions under which we operate upon the living, and the necessity for economising time and material.

In order to reduce such a course to reasonable limits we have then, first, to consider what is to be aimed at and how far any operations upon the cadaver can be of real value to the student. We may admit at once that under no circumstances can such operations realise accurately the conditions of clinical surgery, and that unless great care be taken the results may be not only artificial, but actually misleading. On the other hand, they have the undoubted value of focussing attention upon the anatomy of important regions, and of giving confidence and facility in the handling of

instruments and in dealing with tissues by methods which differ widely from those of the dissecting-room.

Again, we cannot lose sight of the fact that, whatever the value of operations on the dead body as a surgical training, their use as an examination test appears likely to increase rather than to diminish, and that, from this point of view, the selection of the series to be performed is guided by tradition at least as much as by any other consideration.

The actual scope of the course has thus been determined mainly by anatomical considerations, by the influence of examining boards, and by the necessity of providing the largest number of operations with the smallest number of bodies and the least delay. Purely surgical considerations are regarded as of less importance, especially as the great majority of operations actually performed in practice require the presence of some pathological condition, or call for accuracy and detail in such matters as suturing, which cannot well be practised on dead tissues, and the attempt to practise which is apt to weary and disappoint the student. It must therefore clearly be understood that the methods here described are by no means in all cases such as the writer would advise in practice.

The aim and object of the practical course having thus been defined and restricted, it becomes necessary to arrange its working so that the actual manipulations may be rapidly practised, and it is found convenient, during the few available hours, to keep the students fully occupied in *operating*, and to leave all considerations other than those of mere technique for his private reading or for surgical lectures and clinical demonstrations.

With the object of expediting the work of the class-room the writer has been in the habit of providing type-written "notes" which laid down in the briefest form the main points of the operations to be practised, and the students have thus been able to attend each meeting with an accurate knowledge of the manipulations which they would be called upon to perform. The "notes" having been found serviceable in the smooth and rapid working of our classes they are now published—partly for the convenience of our own students, and partly in the hope that they may be of some use to others.

It will be quite obvious that these notes cannot in any way replace the careful study of at least one of the excellent text-books now available, and they are only intended for use in conjunction with such a work—to serve as an indication of the lines to be followed, to assist the student in his own

note-taking, and, if necessary, to refresh his memory during the operation. It is for this reason that ample space is provided for the insertion in manuscript of alternative methods or additional notes.

The illustrations have been added almost as an afterthought, it being found difficult by many to follow a mere written description of an incision. They have all been drawn for me by Mr. Hamilton Irving, and those of the Manchester Medical School who have long been familiar with another use of his pen, will join with me in thanking him for thus further aiding their labours.

REGULATIONS.

Three courses of operative surgery will be held annually—two in the Winter session and one in the Summer session. Each will last for about a fortnight, and the class will meet daily, except on Saturdays, from 4-15 to 6-30 p.m. Not more than 20 students will be admitted to any one course. Senior courses for the higher examinations and for post-graduate work will be arranged concurrently with the above. Dates of meeting and other details will be notified annually in the University Calendar.

The class will be met on alternate days by the Lecturer and the Assistant Lecturer; one of these will take in the order given below operations on the upper half of the body—upper limb, chest, head; the other will take the lower half—lower limb, abdomen.

The student will prepare himself for each day's work by learning the technique of the operations to be practised; during the course he will himself perform about twenty operations and will assist at an equal number. Bodies will be provided in a proportion of one to about every ten students.

Instruments will be provided for the class, but rubber gloves, if worn, must be procured by the student. Every student is most strongly urged to provide himself with an outer garment—a sleeved apron, slop or old frock coat—which must not be worn for any other purpose.

GENERAL INSTRUCTIONS.

The following points are to be considered *before commencing* an operation :—

1. Its exact scope and object.
2. The method to be adopted.
3. The various stages are to be run through mentally.
4. In so doing instruments are to be selected for each stage.
5. The position of the surgeon as regards (a) the part, (b) the light.

In making *skin incisions* note specially :—

1. The skin is not to be dragged or displaced laterally before being incised.
2. The incision must be long enough, and should not require subsequent extension.
3. It must be a single firm cut carried through the whole skin and not “tailing” or branching at the ends.

LIGATURE OF ARTERIES.

Indications :—

1. Arrest of hæmorrhage *in situ*.
2. Arrest of distant hæmorrhage, *e.g.*,
 Carotid for apoplexy.
 Carotid for hæmorrhage of face and throat.
 Brachial for palmar wounds.

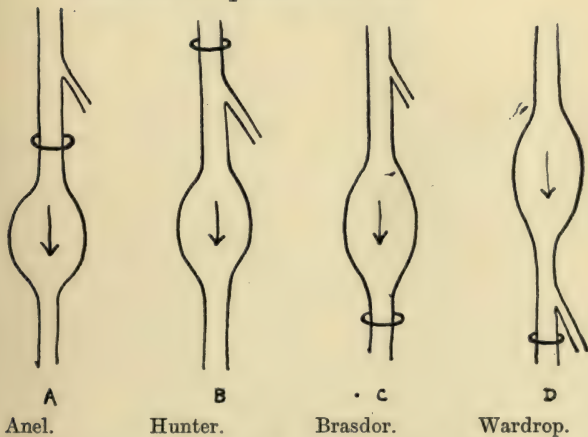


Fig. I.

3. Cure of aneurysms :—

- (a) Proximal and adjacent (Anel).
- (b) Proximal and remote (Hunter).
- (c) Distal of whole trunk (Brasdor).
- (d) Distal of one branch (Wardrop).

4. Miscellaneous for arrest of nutrition :—

Lingual for epithelioma of tongue.

Femoral for elephantiasis.

Thyroids for goitre.

Hence ligature may be at the seat of injury in case of hæmorrhage or in all other cases at a “seat of election.”

Determine seat of election by :—

1. Ready *accessibility* of vessel.
2. Remoteness of *large branches*.
3. Completeness of *control* of required area.
4. Satisfactory *collateral circulation* to allow re-establishment of blood flow, but to prevent too early establishment.

Instruments required : Scalpel, dissecting forceps, retractors, blunt retracting hooks, hæmostatic forceps, blunt dissector, aneurism needle, ligature, scissors, needles, sutures.

The Operation :—

1. Skin incision generally in line of vessel, long enough, firm and without displacing skin; hold scalpel (*a*) for a heavy cut in lightly closed fist with thumb extended (carving knife grip), (*b*) for a light cut in closed hand with extended thumb and index also extended along back of blade (table knife grip).

2. Retraction must be steady and equal on both sides.
3. In cutting through deeper tissues hold knife like pen; cut in straight lines—do not push structures aside with blade of knife; avoid blunt dissection when possible.
4. In cutting on director (which is rarely required) (*a*) for heavy cuts hold knife in closed fist with extended thumb and edge upwards, (*b*) for light cuts pen-grip with edge up; do not cut to extreme edge of director.
5. Arrest minor bleeding points.
6. Pick up sheath (which is only distinct on large vessels) in dissecting forceps (preferably toothed forceps).
7. Open sheath with point of knife, using pen-grip, cutting parallel with artery and making incision about $\frac{1}{4}$ in. long.
8. Separate sheath from artery with blunt dissector and aneurism needle, taking in succession each side of sheath, which is held back with forceps.
9. Pass aneurism needle round and close to artery, passing it from adjacent important structure (*i.e.*, generally from vein).

10. Thread needle. Or this stage may precede the last. Or needle may be passed "armed" with a delicate thread by which is made a loop to withdraw ligature. (Fig. II.)



Fig. II.

11. Withdraw needle (and loop, if one be used).
12. Tie ligature (*a*) strength required to close artery, not to rupture it; (*b*) tie well down *in* the wound: do not drag artery *up*; (*c*) use reef knot, surgical knot, or parallel ligatures (stay knot).

The general directions here given will be found applicable to most operations upon nerves and other miscellaneous operations described below.

EXCISIONS.

Instruments :—

Strong scalpels.

Resection knife with square end.

Retractors.

Hæmostatic forceps.

Dissecting forceps.

Raspatory.

Scissors.

Amputation saw (or Butcher's).

Narrow saw (or Gigli's).

Lion forceps.

Bone cutting forceps.

Sequestrum forceps.

(In surgery classical methods are much modified by diseased conditions, and chisels, gouges, spoons, etc., are required.)

General principles. Free exposure of bone or joint to be removed with minimum of cutting or bruising of soft parts. In many cases the periosteum may be preserved, but sub-periosteal resections are often impracticable in dead bodies of adults, and not always advisable in surgery. Excisions are much easier in diseased than in

healthy joints. In all cases much aid can be given by intelligent assistance in protruding bones, and making ligaments "taut." A good deal of force is often required, and the student must not fear to use it.

In *clearing bones* hold the knife firmly in the fist, but with extended thumb: cut strongly, decidedly and cleanly: always keep edge of knife to bone: never lose sight of point of knife. Complete clearing with raspatory.

In *using saw* hold firmly but lightly: place left thumb-nail on bone near saw and steady the latter with bent knuckle of left thumb resting against blade: draw whole length of blade lightly across bone making first groove: then use light and rapid to and fro movements. Protruded ends of bones about to be sawn off are held firmly in lion forceps.

Bone *cutting forceps* to have bevelled side turned towards the piece of bone which is to be removed.

AMPUTATIONS.

General preparations similar to those for excisions, but add to instruments *amputating knife*; for all major cases a 5 in. blade will do well except for transfixions. In marking flaps hold knife like a scalpel in heavy cutting; use saw-like motion and cut with point. In dividing muscles cut with body of blade. Always use like a carving-knife and not like a needle. For circular cutting, grasp in clenched fist: practice with a paper-knife.

Flaps. Combined length about equal to $1\frac{1}{2}$ diameters of limb at point of section of bone. To include all superficial structures, and never to score the skin. To have well-rounded corners and square-cut or vertical (not bevelled) edge. But bevel a little if there is *much fat*. To contain but little muscle.

Vessels and nerves to be cut square and short. Bone divided as in excision and to be held straight by assistant so as neither to lock saw nor fracture bone.

OPERATIONS ON UPPER HALF OF BODY.

These operations will be performed in the order here given, on alternate days with those of the lower half of the body.

Venesection is now generally employed for infusion of saline solution. The median basilic vein crosses obliquely inwards and upwards from centre of bend of elbow, lying upon the bicipital fascia, beneath which is the brachial artery. Make incision over the vein in its course, clearly define it, and pass two ligatures. Open between the ligatures and introduce cannula upwards. Tie in latter with upper ligature and ligate end of vein. Then remove cannula and tie off vein.

Radial Artery commences $\frac{1}{2}$ in. below centre of fold of elbow. In forearm is superficial except where overlapped by supinator longus. Lies (1) between supinator longus and pronator radii teres; (2) between supinator longus and flexor carpi radialis. Rests on bicipital tendon, supinator brevis, pronator teres, flexor sublimis, flexor longus pollicis, pronator quadratus, radius. The radial nerve is well away to outer side.

Leaving forearm it lies on external lateral ligament of wrist and beneath extensors of thumb,

then passing between heads of abductor indicis to form deep palmar arch.

1. Operation on *back of hand*. An oblique incision from back of styloid of radius to base of second metacarpal opens the "snuff-box" and exposes the artery, between the extensors of the first and second phalanges of the thumb.

2. *Above wrist* a vertical incision external to flexor carpi radialis gives ready access. (Fig. III.a.) Pass needle from without, *i.e.*, from nerve.

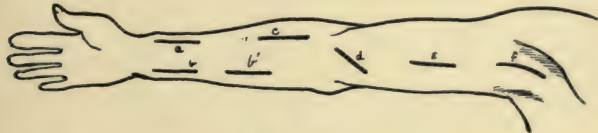


Fig. III.

INCISIONS FOR LIGATURE OF ARTERIES.

a, Radial; c, Radial; b and b¹, Ulnar; d and e, Brachial;
f, Axillary.

3. In *upper third of forearm*. An incision 2½ ins. long commences 1½ ins. below the elbow and runs in line of artery but avoids veins. (Fig. III.c.) Define supinator longus and then pronator teres. Draw these apart. Artery lies between them and overlapped by supinator, radial nerve is well outside and not always visible. Venæ comites here as elsewhere.

Ulnar Artery runs from ½ in. below bend of elbow to superficial palmar arch. Passes under

pronator teres, flexor carpi radialis, palmaris longus and flexor sublimis digitorum. Lies on brachialis anticus and flexor profundus digitorum. About middle of forearm ulnar n. approaches it from within and then lies to inner side. In lower half of forearm artery lies between flexor digitorum sublimis and flexor carpi ulnaris.

Operate in lower two-thirds of forearm. Incision in line from tip of internal condyle to pisiform (Fig. III. *b*, *b*¹); define interval between flexor sublimis digitorum and flexor carpi ulnaris, which may be difficult. Work a little to ulnar side; generally most easy first to distinguish nerve and then artery outside it. Pass needle from within and avoid venæ comites.

Brachial Artery runs from lower border of teres major to $\frac{1}{2}$ in. below bend of elbow. Lies internal to coraco-brachialis, biceps and bicipital tendon. Musculospiral n. behind upper part. Median n. first external, then internal, usually crossing superficially. Ulnar n. internal and only near upper part of artery. Venæ comites. Median basilic vein crosses lower part of artery. Brachial may *bifurcate* at any point above elbow.

1. Operation in *middle of arm*. Hold limb supine and clear of table. Incise along inner border of biceps avoiding and in front of basilic vein. (Fig. III. *e*.) Keep close to biceps until artery and median nerve are exposed. Draw

nerve to more convenient side and pass needle from it.

2. Operation at *bend of elbow*. Oblique incision parallel to and above median basilic vein: (Fig. III.d.), divide bicipital fascia: pass ligature from within (*i.e.*, from median nerve).

Collateral Circulation.

Superior profunda *with* interosseous recurrent
and radial recurrent.

Inferior profunda *with* posterior ulnar recurrent.

Anastomotic *with* anterior ulnar recurrent.

Axillary Artery from middle of clavicle to lower border of teres major at junction of anterior and middle thirds of axilla. Vein in front and internal: nerves closely surrounding. *1st part* from clavicle to pectoralis minor. *2nd part* beneath pectoralis minor. *3rd part* to commencement of brachial.

Operation on 1st part. Incision from coracoid $\frac{1}{2}$ in. below clavicle for 4 ins. inwards: (Fig. IV.e.), divide superficial structures, platysma, and supra-clavicular nerves: avoid cephalic vein at outer end: divide clavicular origin of pectoralis major: expose pectoralis minor: tear gently through costo-coracoid membrane: the vein then presents and is drawn in exposing the artery, which may also be reached by tracing back one of its small branches.

Operation in axilla. Incision in line of artery; (Fig. III.f.) define inner border of coraco-brachialis

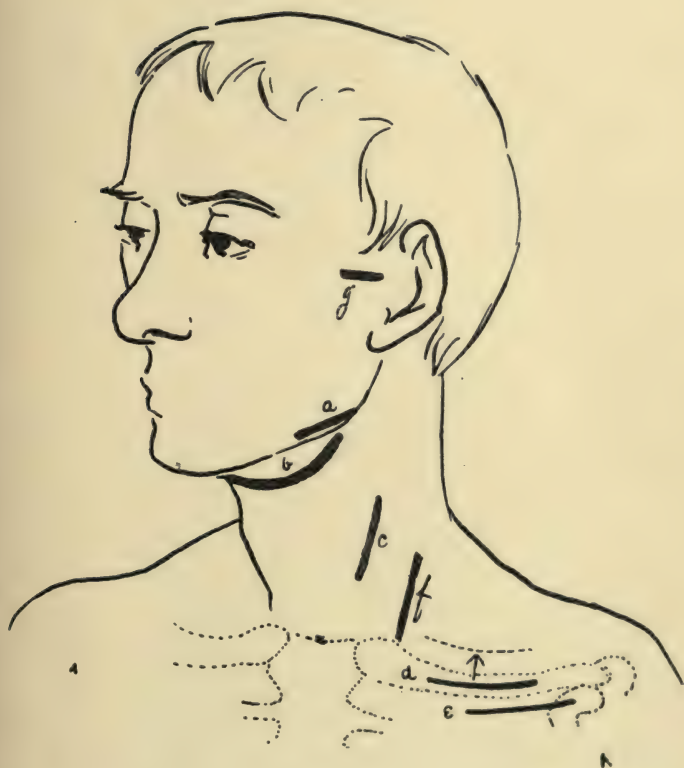


Fig. IV.

INCISIONS FOR LIGATURE OF ARTERIES.

a, Facial; *b*, Lingual; *c*, Carotid; *d*, Subclavian; *e*, Axillary;
f, Vertebral; *g*, Temporal.

and draw it out: draw in axillary vein and ulnar and internal cutaneous n.: pass ligature from within.

Subclavian Artery. Ligature of 1st and 2nd parts is rare. The *3rd part* runs from outer border of scalenus anticus (at its insertion in the scalene tubercle), curves over 1st rib, and ends at lower border of rib beneath centre of clavicle. Has no constant branches. Relations:—In front: skin, platysma, supra-clavicular nerves, deep fascia, clavicle, subclavius muscle and its nerve, external jugular vein and branches, transversalis colli vessels. Above: omohyoid muscle, brachial plexus except lowest cord. Below: subclavian vein. Behind: scalenus medius, lowest cord of plexus, 1st rib.

Operation. Pull shoulder well down and turn away the head. Pull down skin over clavicle and incise along centre of that bone for 4 ins. (*i.e.*, from sterno-mastoid to trapezius, either of which may require partial division). Let skin retract. (Fig. IV.d.) Divide deep fascia. Draw aside (or ligature) external jugular, supra-scapular and transverse cervical veins. Define lower border of omohyoid and trace inwards to scalenus anticus. Define outer border of scalenus anticus and trace down to tubercle. Brachial plexus is now well seen: parallel with it at deepest part of wound

well behind clavicle is the artery. Pass needle from above, keeping very close to artery: the vein is well out of danger, but the plexus is in danger and the last cord especially so: pleura may also be injured.

Collateral Circulation.

Intercostals *with* thoracic branches of axillary.

Supra-scapular and posterior scapular *with* sub-scapular.

Supra-scapular *with* acromio-thoracic.

[Amputations of phalanges may now be practised simultaneously with operations upon the head and neck.]

See p. 41.

Facial Artery curves round lower jaw immediately in front of masseter and has its vein external.

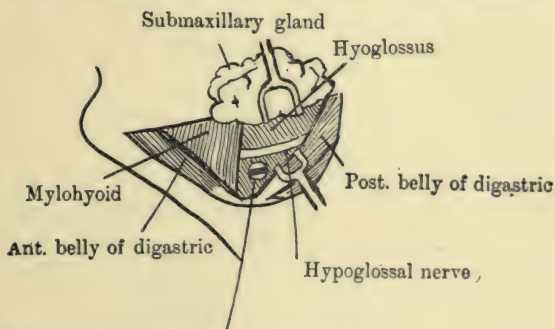
Incise (Fig. IV.*a.*) across it along lower border of jaw dividing platysma: define masseter to find artery.

Lingual Artery arises from external carotid level with great cornu of hyoid: lies on middle constrictor of pharynx and passes under hyoglossus. (Lingual vein is superficial to hyoglossus.)

Make curved incision (Fig. IV.*b.*) from angle of lower jaw to tip of great cornu and thence to symphysis menti. Define submaxillary gland. Divide deep fascia at its lower border. Draw

gland up. Define both bellies of digastric and above these the hypoglossal n. Draw down hyoid and in triangle between digastric bellies and hypoglossal find:—

(a) In front but superficial to hypoglossal the mylohyoid with fibres running up and back. (b) Behind and deeper than hypoglossal the hyoglossus



Window in hyoglossus showing lingual artery

Fig. V.

LIGATURE OF LINGUAL ARTERY.

with fibres running up and forwards. Find posterior border of hyoglossus. Divide this muscle transversely midway between hypoglossal and hyoid exposing the artery. Pass needle from above. (Compare this operation with "Kocher's" method of removing tongue.)

Carotid Artery. Line of direction from sterno-clavicular joint to midway between mastoid and

angle of jaw. Bifurcation opposite upper border of thyroid cartilage. Seat of election for common trunk opposite cricoid and above omohyoid. (For aneurism of the common carotid ligature may have to be applied lower.)

Incision 3 ins. long with centre opposite cricoid and along anterior border of sterno-mastoid (Fig. IV.c.): divide skin, platysma, superficial cervical nerves and deep fascia. Draw back sterno-mastoid. Define and draw down omohyoid, avoiding descendens noni. Carotid sheath is now fully seen and there may be seen crossing it the superior and middle thyroid veins and the sterno-mastoid branch of the superior thyroid artery.

In sheath lie (1) internal jugular vein in front and to outer side; (2) carotid to inner side and often much overlapped by vein; (3) vagus which is well behind. Behind sheath is sympathetic. Open common sheath well to inner side. Then open delicate special sheath for artery. Pass needle from vein.

[Vertebral Artery.] This operation may be substituted for ligature of the carotid in senior course only. It is difficult and of little value. The vessel is running from first part of subclavian to under surface of transverse process of 6th cervical vertebra. Incision 4 ins. long along posterior

border of sterno-mastoid at its lower part (Fig. IV.f.): draw this muscle and external jugular vein well inwards. Define scalenus anticus with phrenic upon it by blunt dissection and draw inwards. Feel for anterior tubercle of transverse process of 6th cervical vertebra ("carotid tubercle"). This indicates interval between scalenus anticus and longus colli and over this interval lies ascending cervical artery. Deeper in the interval and just below the tubercle lie vertebral vessels, vein anterior. Define these carefully as sympathetic is in close contact, draw vein outwards and pass needle from without.]

Temporal Artery runs vertically over root of zygoma about $\frac{1}{4}$ in. in front of ear lying in a very dense fascia with vein behind: auriculo-temporal is in close company and small branches of facial n. cross it. Make horizontal incision 1 in. long forwards from tragus along upper border of zygoma (Fig. IV.g.) and carefully define artery as indicated.

Middle Meningeal Artery. Entering skull by foramen spinosum crosses anterior inferior angle of parietal bone and ramifies outside dura mater. Anterior branch is found inside skull at a point $1\frac{1}{2}$ ins. behind and $\frac{1}{2}$ in. above external angular process of frontal bone.

At this point thrust a pointed instrument (bone drill) through scalp and scratch a mark on skull. Round this make curved incision of about $\frac{3}{4}$ circle 1 in. in radius and with base of flap downwards. Reflect this flap, which contains temporal muscle, down to bone. Pass suture with fine curved needle through dura and round vessel using suture as the ligature.

Tracheotomy and other operations on Air Passages. The Larynx extends to lower border of 6th cervical vertebra and the trachea for $4\frac{1}{2}$ ins. further, a great part of it being behind sternum. (Child's larynx is smaller in proportion.) Superficial to whole tube are skin, superficial fascia and one layer of deep fascia: anterior jugular veins may be very close to middle line or present large intercommunications. Sterno-hyoid muscles meet in middle line above and sterno-thyroids meet below. Thyroid isthmus crosses trachea at variable level usually 2nd, 3rd, and 4th rings. At sternal notch trachea is 2 ins. or more in depth and may be overlaid by thyroidea ima, innominate artery, left brachio-cephalic vein or thymus (in infant).

Bronchotomy or opening air passages may be:—

1. Subhyoid pharyngotomy.
2. Thyrotomy or splitting thyroid.

3. Laryngotomy in cricothyroid space.
4. Laryngo-tracheotomy, through cricoid cartilage.
5. Tracheotomy—*a.* above isthmus.
b. through isthmus.
c. below isthmus.

1 and 2 are for removing tumours. For obstruction of respiration select in urgent cases among adults 3 or 4, in children and ordinary cases among adults select 5*a*. But the operation must be below the obstruction, although 5*b* or 5*c* are difficult and dangerous.

Laryngotomy and tracheotomy will be practised.

Instruments :

Scalpel.

Dissecting forceps.

Retractors.

Hæmostatic forceps.

Trachea hook with groove.

Dilator.

Tubes and Tapes.

Laryngotomy. Stand on right: throw back head: define cricoid: incision vertical for $1\frac{1}{2}$ ins. with centre above cricoid: retract freely: hook cricoid downwards; open cricothyroid membrane

transversely: introduce tube. Cricothyroid vessels are small and close to cricoid.

Tracheotomy above isthmus. Similar position, &c., but incision lower. Hook down thyroid isthmus if seen. Introduce trachea hook with a good hold. Slip knife along groove in hook with edge upwards and cut the rings upwards: introduce dilator and then tube.

Resection of a portion of Rib; will be practised by most students as illustrating use of instruments, and may be performed in various positions concurrently with above operations. Incision 3 ins. long parallel with rib and through periosteum. With raspatory clear rib inside periosteum. Cut out a portion, 1 in. long, with bone cutting forceps, (*a*) introduce forceps from above, (*b*) turn bevelled edge to piece of bone to be removed. Tear away fragment of bone. Open pleura by thrusting in forceps and separating blades in line of incision. Remove periosteum.

Musculo-spiral Nerve. Incision internal to upper part of belly of supinator longus, avoiding cephalic vein. Divide deep fascia. Draw supinator longus and radial extensors outwards. Nerve lies somewhat deeply between these and brachialis anticus, and is accompanied by superior profunda artery.

Supra-orbital Nerve. Define notch if possible. Short horizontal incision beneath eyebrow with centre at junction of inner and middle thirds of superior orbital margin. (Fig. VI.a.) Divide orbicularis. Nerve is seen running up with artery to outer side. Hook it well up and trace back to



Fig. VI.

INCISIONS TO DEFINE NERVES.

a, Supra Orbital; *b*, Infra Orbital; *c*, Facial; *d*, Spinal Accessory.

notch. Separate from edge of notch by tenotome and pull out. Cut away distal ends.

Infra-orbital Nerve. Foramen is in line from supra-orbital notch to interval between bicuspid and $\frac{1}{4}$ inch below margin of orbit. Incise obliquely

in fold of cheek (down and out) with centre over this point. (Fig. VI. *b.*) Divide fibres of zygomaticus major, orbicularis palpebarum and levator labii superioris. Define foramen and nerve. Then proceed as before.

Facial Nerve. Incision from just behind external meatus along anterior border of mastoid and sterno-mastoid to level of angle of jaw. (Fig. VI. *c.*) Draw parotid forward and expose digastric. Above digastric the nerve runs forward from centre of mastoid, parallel with digastric and on a level with tip of lobule of ear. The deep parts must not be cut and the recognition of the nerve is difficult in the dead body.

Spinal Accessory runs down and out at right angles to centre of line from angle of jaw to apex of mastoid. Incision along anterior border of sterno-mastoid from ear to great cornu of hyoid. (Fig. VI. *d.*) Divide deep fascia. Draw back sterno-mastoid. Expose digastric and find nerve emerging from its lower border. The nerve runs well beneath the sterno-mastoid before entering it.

[The Gasserian Ganglion may be removed by students taking senior course only.]

[Excision of Wrist by Lister's method may be practised by senior class.]

Excision of Elbow. Hold limb across patient's body, with thumb upwards. Vertical incision 5 ins. long with centre over tip of olecranon. (Fig. VII.) Split triceps and separate it from olecranon but not from fascia of forearm. Cut off olecranon with bone cutting forceps. Clear hollow between base of olecranon and inner condyle, keep-



Fig. VII.

EXCISION OF ELBOW.

ing close to bone and especially avoiding bruising of ulnar nerve; retract strongly and separate origin of flexor carpi ulnaris from condyle. Divide internal lateral ligament. Clear outer side of bones separating insertion of anconeus and origins of extensors of wrist and dividing external lateral

ligament. Protrude humerus, retract soft parts fully, interpose spatula between them and the bone, and saw off latter below tips of condyles. Then protrude and saw off ends of radius and ulna.

Excision of Shoulder. Incision from just outside coracoid downwards and running through deltoid to bone. (Fig. VIII.) Find bicipital groove; open sheath of tendon and draw tendon inwards. Evert limb and separate subscapularis



Fig. VIII.

EXCISION OF AND AMPUTATION AT SHOULDER.

from inner tuberosity. Invert limb and separate spinati and teres minor from outer tuberosity. Divide lax capsule and protrude head of humerus which is cut off.

[In practice it is better, if possible, to operate subperiosteally, and spare the rotator muscles attached to the tuberosities, and the glenoid may have to be cut away.]

Excision of Upper Jaw. Stand to right of subject. Extract central incisor tooth. Commence incision at X in Fig. IX. and carry it (a) from



Fig. IX.

EXCISION OF JAWS.

inner angle of orbit, down side of nose, round ala to middle line and through lip into mouth; (b) outwards along margin of orbit on to malar bone.

Incision must lie in the skin folds not skirting them as in diagram. Cut down to bone throughout. Reflect flap outwards. Separate periosteum of orbit and protect orbital contents. Raise nose from bone. Saw partially through (*a*) alveolus and hard palate, (*b*) nasal process, (*c*) malar bone into speno-maxillary fissure. Complete these bone sections with forceps, levering jaw up a little at each cut. Separate soft from hard palate with knife; seize jaw in lion forceps and break connections with pterygoid process, palate bone and ethmoid bone.

Excision of Half Lower Jaw. Extract central incisor. Cut from centre of chin to its tip and thence along lower border of jaw to angle and upwards to just below level of ear lobule (Fig. IX.), securing facial vessels and cutting down to bone. Carry flap up, clearing masseter from bone and cutting reflection of mucosa of cheek on to alveolus. Divide jaw close to centre (best with Gigli's saw). Draw bone outwards, dividing mucosa on inner side, mylo-hyoid, internal pterygoid, and inferior dental vessels and nerves, then insertion of temporal and finally external pterygoid and capsule; this is best done with scissors.

[The two following paragraphs refer to both hand and foot, and several minor amputations

may be performed on the fingers and toes during progress of other operations.]

Amputation of a Terminal Phalanx. Separate adjacent digits by strips of bandage. Face limb with its dorsum upwards. Seize phalanx in left hand and flex to a right angle. Define joint with nail of left thumb. Cut across dorsum below joint and carry knife back into joint. Divide lateral ligaments. Passing the narrow knife through the joint, cut a palmar (or plantar) flap from within, making flap long enough and square enough to cover the surface.



Fig. X.

AMPUTATION OF PHALANX.

Amputation of a Proximal Phalanx by oval or racquet-shaped incision. Separate digits, and define joint as before. Incision in middle line of metacarpal (or metatarsal), commencing $\frac{1}{2}$ inch to 1 inch above joint, and running to level of web. (Fig. XI.). Let incision then diverge to each side, the two branches meeting on the palmar (or plantar) surface below the web and forming a racquet-shaped cut. Divide deep structures, tendons and ligaments, opening joint from palmar

(plantar) aspect. In the case of large joint surfaces, as *thumb* and *great toe*, the "handle" of the racquet must be prolonged well on to the proximal phalanx before diverging to cut the flap.

For *little finger* make first incision slightly to radial side of metacarpal; and for *index finger* to ulnar side, so as to remove scar from pressure on side of hand.

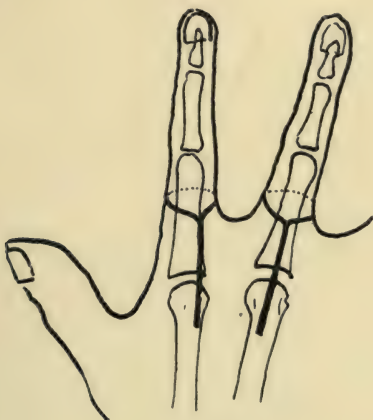


Fig. XI.

AMPUTATION OF FINGER.

In the hand the head of a metacarpal may (for appearance) be removed obliquely by bone forceps, but this causes much weakening and is not to be done in the foot.

Amputation of or through the *second phalanx*

may be done by anterior or posterior or even by lateral flaps.

The **forearm** will be amputated about its centre by antero-posterior flaps; the **upper arm** at its lower part by the circular method, and at its upper part by transfixion. These operations are carried out on general principles, and require no detailed description.

Amputation at the Shoulder Joint (Spence's or oval method). Make a vertical incision, similar to that for excision. At its lower end let two cuts diverge in the usual "oval" form, these meeting at back of arm. (Fig. VIII.) The outer cut is carried down to bone, the inner through superficial structures only. Reflect all outer part of flap thus cut, keeping close to bone and dividing muscles attached to outer tuberosity. Divide biceps tendon, cut through capsule, rotate arm out and clear inner tuberosity. Protrude head of humerus and carry knife down inner side of bone, then outwards through original skin incision—the last cut going through main vessels and nerves.

OPERATIONS ON LOWER HALF OF BODY.

These operations will be performed in the order here given on alternate days with those of the upper half of the body.

Radical Cure of Inguinal Hernia (Bassini's). Incision about 4 ins. long in line of inguinal canal; carry to aponeurosis of external oblique and separate superficial parts from aponeurosis for slight distance on either side, defining external ring. Divide aponeurosis cleanly in line of its fibres and separate from internal oblique. Pick up spermatic cord and hold inwards (if a sac be present define it in front of cord, reduce contents, tie neck and cut away). Define lower arched border of internal oblique. Evert outer flap of external oblique aponeurosis to define Poupart's ligament. Suture (3 or 4 sutures) internal oblique to Poupart below cord. Lay cord on internal oblique. Suture aponeurosis over cord with continuous suture.

Castration. Incision about 3 inches long in line of lower part of inguinal canal, divide

oblique aponeurosis. Expose cord, and trace as far up as possible. Doubly ligature high up, and divide between ligatures. Drag up testis by lower end of divided cord, and remove through opening in groin; or make a second incision in the scrotum, and drag testis through it. May complete by suturing, as in Bassini.

Removal of Vermiform Appendix. Incision in right flank about 3 inches long, parallel with fibres of external oblique and having junction of lower and middle thirds about opposite, and 1 in. inside anterior superior spine. Divide superficial structures. Split external oblique in line of incision. Retract well. Split internal oblique in line of its fibres at centre of incision and at right angles thereto. Carry split through transversalis. Retract these two deeper muscles upwards and downwards. Pick up in forceps and divide transversalis fascia and peritoneum in line of original incision. Introduce finger, draw out cæcum, and trace longitudinal muscular bands downwards to find root of appendix. Bring out appendix. With aneurism needle transfix meso-appendix, and tie in two sections. Cut appendix away from meso-appendix, and clear up to cæcum. Crush its base in Spencer Wells' forceps. Cut across crushed area, removing appendix. Invaginate

base, and close aperture (purse-string suture if possible). Suture (1) incision in peritoneum and transversalis fascia; (2) split of internal oblique and transversalis muscles; (3) split of external oblique; (4) skin, etc.

Colotomy. Open abdomen, as in removal of vermiform appendix, but on left side. Introduce finger and hook up colon, which is recognised by its longitudinal bands and appendices epiploicæ. Draw loop well out and as far down as possible, so as to reach highest available point of gut. Transfix meso-colon with glass rod or Spencer Wells' forceps, which retains loop outside abdomen.

Gastrostomy (Frank's). Incision 3 ins. long, vertical, over centre of left rectus abdominis, and beginning 1 in. below costal margin. Carry this through sheath of rectus. Split fibres of rectus in whole length. Retract. Pick up and divide in length of incision posterior sheath of rectus and then peritoneum. Introduce index and middle fingers of left hand upwards and to left, grasping stomach, which has very thick wall, and may lie under left lobe of liver. Pull stomach well out in form of cone, protruding some 2 ins. Transfix its wall with suture, taking good hold of apex of cone, but not penetrating mucosa of stomach.

Suture outer coats of stomach at base of cone to parietal peritoneum of original wound. Make second incision 1 in. long opposite centre of first incision, and 1 in. to left of it; carry this down to sheath of rectus. Raise superficial structures from the sheath in form of a bridge between the incisions. Then, by means of ligature in stomach cone, drag latter under bridge and out at second incision. Stitch up first incision. Suture stomach to margins of second incision, open it and introduce a catheter.

In female bodies the abdomen will be opened in the middle line above the symphysis pubis, the bladder being avoided, and the *uterus* and its *appendages* will be clearly defined by touch, after which *oöphorectomy* may be performed.



FIG. XII.

INCISION FOR
LIGATURE OF
ARTERIES.

a Anterior tibial
b Dorsalis pedis

Dorsalis Pedis Artery continues line of anterior tibial from centre of front of ankle to base of first inter-osseous space. Superficial except for inner tendon of exterior brevis digitorum. Lies in angle between extensor proprius hallucis and extensor longus digitorum. Has anterior tibial nerve to outer side.

Incision in line of vessel and through deep fascia (Fig. XII. b.). Students tend to make

this incision too low down and to tie dorsalis hallucis.

Pass ligature from the nerve.

Anterior Tibial Artery from bifurcation of popliteal runs through interosseous membrane to front of leg. Thence in a line from upper tibio-fibular joint to the middle of the front of the ankle, where it is crossed by the extensor proprius hallucis. Lies deeply on interosseous membrane between tibialis anticus and extensor communis digitorum; later between tibialis anticus and extensor proprius hallucis. Venæ comites on either side. Anterior tibial nerve is external above and below, but in middle, of course, is superficial or even internal, twice crossing superficially.

Operation *on upper third*. Incision in vertical line, midway between crest of tibia and head of fibula (Fig. XII. a.); dorsiflex the foot; work through gap between tibialis anticus and extensor communis, defining this gap by blunt pressure and incising deep fascia; work towards border of tibia, exposing vessels and nerve on interosseous membrane; pass needle from without.

In *middle of leg* gap between tibialis anticus and extensor communis is better marked; the extensor hallicus also lies to outer side of artery; the nerve is nearer the vessel and often superficial to it.

Above the ankle artery is more superficial and between tendons, its termination being crossed by extensor hallucis.

Posterior Tibial Artery from bifurcation of popliteal at lower border of popliteus runs in a line from centre of popliteal space to midway between internal malleolus and inner tuberosity of os calcis. Lies beneath soleus and inter-muscular fascia upon (1st) tibialis posticus, (2nd) flexor longus digitorum; at the ankle lies on tibia



Fig. XIII.

INCISIONS FOR LIGATURE OF ARTERIES.

a, Popliteal; *b*, Posterior Tibial; *c*, Posterior Tibial.

between flexor longus digitorum and flexor hallucis. Has venæ comites. Post tibial nerve, at first internal, soon crosses superficially, and is external at the ankle.

Operation in *the middle of the leg*. Vertical

incision a good $\frac{1}{2}$ in. behind tibia (Fig. XIII. b.); divide deep fascia; draw back gastrocnemius, cut through soleus and its intra-muscular fascia, directing depth of cut towards outer border of tibia; flex knee and plantar-flex foot; draw back soleus; divide thin inter-muscular septum; expose artery lying on gap between flexor longus digitorum and tibialis posticus; pass needle from without.

Operation *at ankle*. Curved incision $\frac{1}{2}$ in. behind internal malleolus (Fig. XIII. c.); cut through annular ligament; avoid opening tendon sheaths, but pass between flexor digitorum (in front) and flexor hallucis (behind); pass needle from behind.

Popliteal Artery continues superficial femoral from opening in adductor magnus to lower border of popliteus; lies on femur, posterior ligament of knee and popliteus, running from inner side to middle of limb. Is crossed from without inwards by its vein (closely adherent) and by internal popliteal nerve (more superficial). Overlapped above by semi-membranosus and below by gastrocnemius and plantaris.

Operate in *upper part*. Abduct and evert limb and flex knee to right angle; incision parallel to and close behind tendon of adductor magnus (Fig. XIII. a.); draw back sartorius and internal

saphena vein; draw adductor magnus forward and semi-membranosus backward; define artery close to femur with thick vein more external (behind), but readily mistaken for artery; pass needle from without (*i.e.*, from below upwards).

Collateral circulation:—

Anastomotica magna. Superior articular branches of popliteal (if ligature be low enough). Descending branches of external circumflex.	}	with	{	Inferior articular branches of popliteal. Anterior tibial recurrent.
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Femoral Artery runs from Poupart to opening in adductor magnus, in line from $\frac{1}{2}$ in. internal to centre of Poupart to base of internal condyle. First one or two inches are "common femoral," rest is "superficial." In upper third of thigh the vessel lies in Scarpa's triangle, below this in Hunter's canal. Vein is internal at the groin, then passes behind and is external in Hunter's canal.

1. Operation *at the groin*. Incise in line of vessel (Fig. XIV. b.), and divide cribriform fascia, avoiding lymph glands, superficial external pudic and superficial epigastric arteries and several veins; open sheath, avoiding crural branch of genito-crural, which lies on its outer side; pass ligature from the vein; vein is internal in a separate sheath; anterior crural nerve is $\frac{1}{2}$ in. external.

2. Operation *in Scarpa*. (This triangle is formed by Poupart and by the inner border of the sartorius and adductor longus, which meet at the apex 4 ins. below Poupart.) Abduct and evert limb; incision 4 ins. long with its centre 4 ins. below Poupart and in line of artery (Fig. XIV. c.); divide fascia lata; draw outwards sartorius (its fibres incline down and in); expose sheath, which has long saphenous nerve external, and is crossed by anterior crural branches; sheath contains artery and vein (latter behind); pass needle from within.

Collateral circulation :—

External and internal circumflex	with	{ Muscular of femoral, anastomotica magna. Superior articular of popliteal
Profunda	with	{ Muscular of femoral. Articular of popliteal.

3. Operation *in Hunter's Canal* (which is formed by tendinous expansion from adductors longus and magnus to vastus internus, and which encloses femoral vessels and long saphenous nerve). Abduct thigh; incise along middle third in line of artery (Fig. XIV.d); incise fascia lata; draw sartorius *well* inwards; open canal; expose artery with vein behind and external and with internal

saphenous nerve in front; pass ligature from without.



Fig. XIV.

INCISIONS FOR LIGATURE OF ARTERIES.

a and *a'*, External Iliac; *b*, *c* and *d*, Femoral.

Collateral circulation by profunda and its branches.

Of the *three operations*: 1, is easiest but deprives limb of profunda femoris and gives poor anastomoses; 2, is much easier than 3 and free from objection; hence use 2 if practicable and prefer ligature of external iliac to 1.

The Iliac Arteries. The aorta bifurcates to the left of the 4th lumbar vertebra or $\frac{3}{4}$ in. below and to left of umbilicus. The *common iliac* artery is 2 ins. long and bifurcates in front of the sacroiliac joint. The *external iliac* runs round the pelvic brim to a point $\frac{1}{2}$ in. internal to the middle of Poupart's ligament; before terminating it gives off the deep epigastric and circumflex iliac. The *internal iliac* runs down and backwards into the pelvis for $1\frac{1}{2}$ ins. The *veins* lie inside and behind the arteries but both common veins pass behind the right common artery to unite on its outer side. The *ureter* crosses the bifurcation of the common iliac and the *vas* is 2 or 3 ins. lower.

External Iliac Artery.

1. *Abernethy's operation.* Curved incision from $\frac{1}{2}$ in. above and external to middle of Poupart's ligament to $1\frac{1}{2}$ ins. above and internal to anterior superior spine (Fig. XIV.a); divide skin, superficial fascia, external oblique, internal oblique and transversalis; divide transversalis fascia very carefully; strip up peritoneum with ureter and vas, exposing iliacus and rounded tendon of psoas; internal to

this tendon are the vessels with genito-crural nerve on outer side; keeping close to the artery pass the needle from within.

2. *Cooper's operation.* Incision just above and parallel to Poupart's ligament across course of artery (Fig. XIV. *a*¹). Is easy on cadaver but difficult with aneurism in the groin and comes close to the large branches.

3. *Transperitoneal operation* is less suitable for external iliac.

Collateral Circulation.

Deep epigastric *with* internal mammary, lumbar and intercostals.

Circumflex iliac *with* ilio-lumbar, lumbar and gluteal.

Circumflex arteries and profunda *with* branches of internal iliac.

[The **common** and **internal iliac arteries** and the **aorta** can be reached by an operation similar to Abernethy's (on left side for aorta), but the transperitoneal method is simpler and better. These operations need not be practised.]

Excision of Ankle will be performed by two lateral incisions. (Fig. XV.)

(1) *External incision* in lower $2\frac{1}{2}$ ins. of posterior border of fibula, curving round tip of malleolus to

within 1 in. of base of 5th metatarsal. This lies in front of peroneal tendons and is carried down to bone. Clear thoroughly lower end of fibula. With narrow saw or forceps divide fibula 2 ins. above tip of malleolus; divide external lateral ligament and remove malleolus.



Fig. XV.

EXCISION OF THE ANKLE JOINT.

(2) *Internal incision* with a similar curve over lower 2 ins. of tibia, below internal malleolus and forward to tubercle of scaphoid. This lies in front of posterior tibial tendons and vessels. Divide internal lateral ligament close to tibia. Clear the bone thoroughly. Evert foot strongly. Pass

narrow saw through to external wound (in front of joint) and cut off lower end of tibia. Then saw off head of astragalus or remove whole bone.

Another good method in aseptic cases is by *incision across front of ankle*, dividing all tendons,

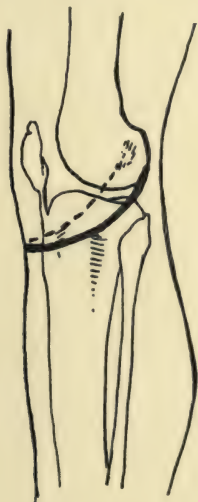
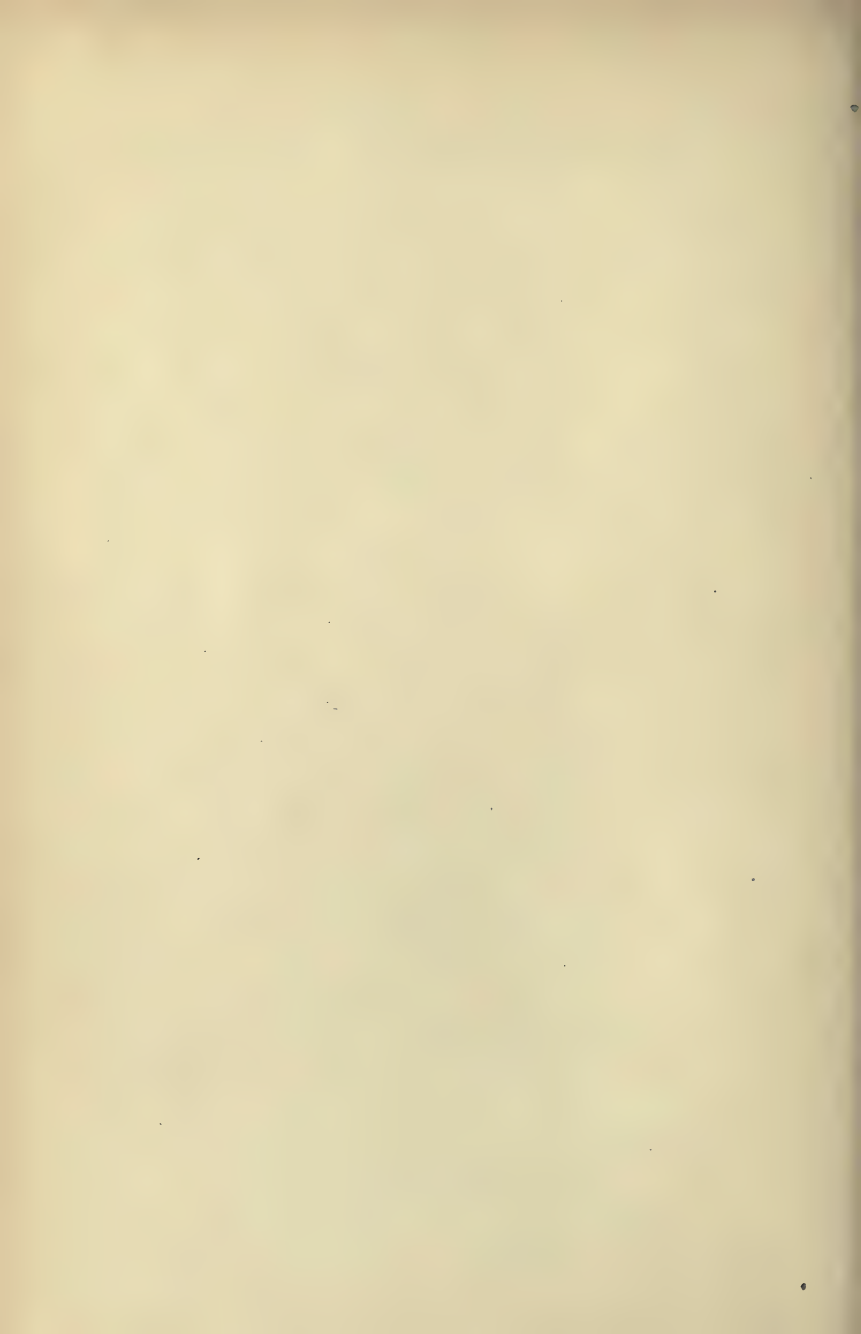


Fig. XVI.

EXCISION OF THE KNEE.

which are at once secured each to each by loose sutures, the latter being tied up at end of operation.

Excision of Knee. Curved incision from back of one condyle to tubercle of tibia and up again to



back of other condyle. (Fig. XVI.) Reflect flap going through ligamentum patellæ and excise patella if necessary. Flex knee and divide lateral and crucial ligaments. Protrude end of femur; clear bone at line of section and cut off just above articular cartilage parallel with condylar surface. Remove synovial pouch in front of femur. Clear head of tibia and saw off about $\frac{1}{2}$ in. of bone.



Fig. XVII.

EXCISION OF THE HIP.

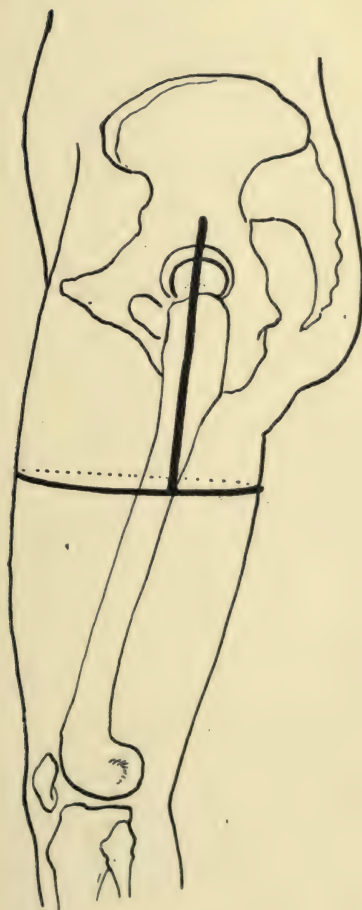


Fig. XVIII.

EXCISION OF AND AMPUTATION AT THE HIP.

Excision of Hip.

(1) *Anterior Method.* Incision about 4 ins. long from anterior superior spine downwards and a little inwards between (1) tensor fasciæ and sartorius, (2) gluteus minimus and rectus. (Fig. XVII.) Open capsule freely. Cut across neck of femur obliquely downwards and inwards with Adam's saw. Turn out head (which is difficult in cadaver with intact ligamentum teres). Deal with acetabulum.

(2) *Posterior Method.* Incision 5 ins. long from 2 ins. above great trochanter downwards; this goes vertically over trochanter or curves behind it. (Fig. XVIII.) Cut down to bone and free muscles from top and back of trochanter. Open joint and saw across neck of femur or divide immediately below trochanter according to extent of disease. Seize upper fragment in lion forceps and twist it out, dividing all muscular attachments close to bone. Deal with acetabulum.

Amputation of Phalanges and Toes. See pp. 41 and 42.

Lisfranc's Amputation of Metatarsus. (Fig. XIX.) Stand at foot of body. Define with thumb and index finger of left hand bases of 1st and 5th metatarsals at a level well down towards the sole. Make cut across dorsum between these points,

slightly convex forwards and extending to bone. Mark out plantar flap with base at ends of dorsal cut, extending to balls of toes and longer on inner side. In this cut point of knife is carried to bone but flap is not reflected. Returning to dorsum

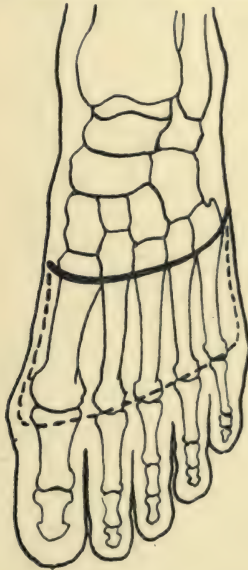


Fig. XIX.

LISFRANC'S AND HEY'S AMPUTATION.

disarticulate metatarsus with division by point of knife of ligament between internal cuneiform and second metatarsal. Pass through joint to plantar surface strongly plantar-flexing foot with heel as fulcrum. Turn knife edge forward and cut plantar

flap from within outwards into incision already marked out, the knife keeping close to bone throughout the flap.

Hey's Operation. Similar but cut across re-entering base of second metatarsal. This gives a

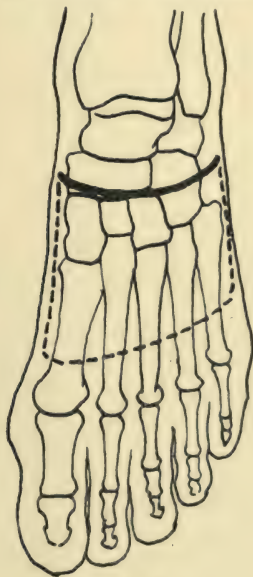


Fig. XX.
CHOPART'S AMPUTATION.

straighter stump. Some surgeons cut across internal cuneiform instead of second metatarsal.

Chopart's Operation at medio-tarsal joint. (Fig. XX.) Define tubercle of scaphoid and correspond-

ing point on outer side which is midway between tip of malleolus and base of 5th metatarsal. Unite by dorsal cut with convexity forwards. Define plantar flap longer on inner side and reaching to within an inch of root of toes. Return to dorsum and open calcaneo-cuboid and astragalo-scaphoid (medio-tarsal) joints. Pass through joints and cut plantar flap from within.

Subastragaloid Amputation (Faraboeuf or Perrin slightly modified.) Commence incision $\frac{1}{2}$ in.

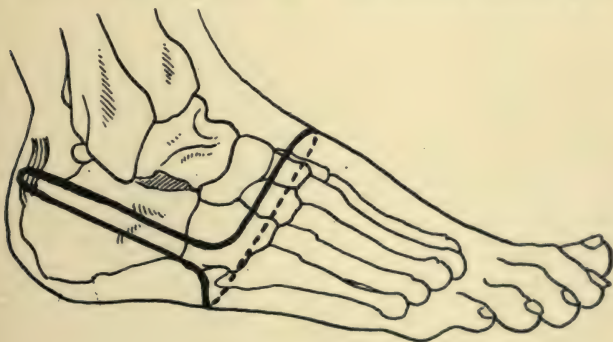


Fig. XXI.

SUBASTRAGALOID AMPUTATION.

below tip of external malleolus. Run forward to level of base of 5th metatarsal. Pass across dorsum in front of scaphoid. Run across inner side of foot and across sole. On returning to outer side run back parallel with and $\frac{1}{2}$ in. below first cut, until tendo Achillis is reached. Then curve

back to first cut. (Fig. XXI.) Carry incision to bone throughout. Reflect flaps as far as practicable. Open astragalo-scaphoid joint. Forcibly extend and invert foot dividing astragalo-calcaneal ligament. Divide tendo Achillis at insertion. Separate soft parts from os calcis close to bone. Find and cut short the tibial nerves.

Syme's Operation—immediately above the ankle. Define with left thumb and forefinger tip of ex-

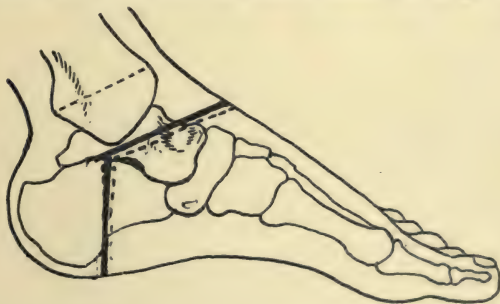


Fig. XXII.

SYME'S AMPUTATION.

ternal malleolus and a corresponding point $\frac{1}{2}$ in. below and a little behind tip of internal malleolus (Fig. XXII.) Unite these by (1) Vertical incision across heel; (2) Transverse incision across dorsum; both incisions go to bone. Open front of ankle. Divide lateral ligaments, strongly plantar-flexing foot. Pass through joint. Dissect calcaneum out of heel flap by dividing tendo Achillis and keeping

close to bone with excision knife. (Many surgeons raise heel flap before opening ankle.) Reflect soft parts from lower end of tibia and fibula keeping very close to bone. Saw across tibia and fibula immediately above articular cartilage. A small counter opening in heel flap is generally advised, but is not required.



Fig. XXIII.

PIROGOFF'S AMPUTATION.

Pirogoff's Operation is closely similar but leaves posterior part of os calcis, which is attached to lower end of tibia. Incisions as in Syme but heel cut is a little oblique and in front of vertical plane. Open joint as before and at once remove lower end of tibia and fibula. Then apply saw to back of upper part of os calcis and cut through it in same plane as the heel cut (dotted line in Fig. XXIII.). Suture os calcis to tibia. (Many surgeons con-

demn this operation but the method here described—which differs a little from that of most books—gives very good results).

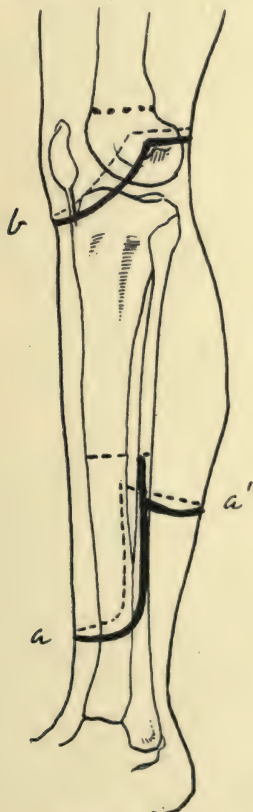


Fig. XXIV.

LISTER'S AMPUTATION OF LEG AND CARDEN'S AMPUTATION
THROUGH CONDYLES.

Amputation of Lower Third of Leg(Lister's). Stand on right of limb. On inner side make vertical incision equal in length to diameter of limb: on outer side a similar incision but running one inch higher (Fig. XXIV.a). Unite these at lower ends by cut across front of limb, rounding off angles. Unite across back of limb by a cut level with upper end of inner incision and therefore an inch below that of outer incision (Fig. XXIV.a¹); this cut is slightly convex downwards and extends to bone. Raise anterior flap, making as thick as possible. Clear tibia and fibula to level of top of outer incision. Cut across bones, finishing tibia first, and rounding off its angle.

Amputation at Seat of Election by *Hooded Flap*. Stand to right of limb. Place thumb on crest of tibia 3 ins. below tubercle and index finger in centre of calf immediately behind the tubercle. Insert point of knife at latter point: cut a well-rounded flap from the more distant side of the limb, the flap extending 5 ins below the posterior starting point and 2 ins. below the anterior point to which the knife is brought up. Then cut a similar flap on near side of limb. (Fig. XXV.) The inner flap should be a little the longer. Raise

the flaps including muscle and *periosteum*. Divide bones a hand's breadth below the knee joint, rounding off the tibia.



Fig. XXV.

AMPUTATION OF LEG AT "SEAT OF ELECTION."

Amputation through the Knee (Stephen Smith). Stand to right of limb. Define tubercle



Fig. XXVI.

STEPHEN SMITH'S AMPUTATION.

of tibia and centre of popliteal space. Start at latter point and cut well rounded incision on fur-

ther side of leg coming up to tubercle. Then similar cut on near side of leg, returning to starting point. Inner flap should be a little larger (Fig. XXVI). Raise flaps, gradually deepening to bone, and extending up to line of knee. In so doing divide ligamentum patellæ. Cut into knee below semilunares, leaving these on femur to maintain connections of fascia of thigh. Pass through all ligaments. Cut across vessels and tendons at back of knee transversely.

Amputation through Condyles (Carden). Cut a long well-rounded anterior flap with its base at prominent point of condyles and arching below patella (Fig. XXIV.b). Raise this including patella. Cut straight across limb behind condyles. Clear condyles and saw across, parallel to condylar surface.

Lister's operation makes a shorter anterior flap and takes some posterior flap.

Gritti's resembles Carden's, but posterior surface of patella is cut off and remainder of bone attached to cut surface of condyles.

Stokes' resembles *Gritti's*, but the femur is divided above the condyles.

Amputation of the Thigh is to be practised by any of the general methods:—

Circular.

Skin flaps and circular division of muscles.

Transfixion.

Amputation at Hip Joint. The femoral or external iliac artery may be first ligatured.

Perform a circular amputation in upper third of thigh, cutting through femur, and at once secure principal vessels. Then make vertical external incision as for excision of hip and extending into circular cut: remove upper part of femur subperiosteally if possible (Fig. XVIII.). (Esmarch.)

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